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(54) APPARATUS FOR MUSCLE STIMULATION

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A61H 1/02	(2006.01)
A61H 5/00	(2006.01)
A63B 24/00	(2006.01)

(52) U.S. Cl.

CPC ***A63B 24/00*** (2013.01); ***A61H 1/003*** (2013.01); ***A61H 1/0237*** (2013.01); *A61H 1/0274* (2013.01); *A61H 2201/0157* (2013.01); *A61H 2201/1215* (2013.01); *A61H 2201/1635* (2013.01); *A61H 2201/164* (2013.01); *A61H 2201/5061* (2013.01); *A61H 2201/5071* (2013.01)

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CPC A63B 24/00; A63B 21/072; A63B 22/00; A63B 2200/0017; A63B 2022/0053; A63B 22/0015; A63B 22/0048; A63B 22/0056; A63B 23/03533; A63B 23/03541; A61H 1/00; A61H 1/02; A61H 1/0237; A61H 1/024; A61H 1/0262; A61H 1/0266; A61H 2201/00; A61H 2201/0157; A61H 2201/12; A61H 2201/1215; A61H 2201/1223; A61H 2201/123; A61H 2201/1253; A61H 2201/1261; A61H 2201/14; A61H 2201/1436; A61H 2201/1481; A61H 2201/149; A61H 2201/164; A61H 2201/50; A61H 2201/5005; A61H 2201/5058; A61H 2201/5061; A61H 2201/5064; A61H 2201/5071; A61H 2203/0406; A61H 2205/00; A61H 2205/10; A61H 2205/12

USPC 482/1, 4–7, 51–53; 601/5, 23, 27, 601/29–35, 84, 89, 90, 92, 93, 97, 98, 100, 601/101, 104

See application file for complete search history.

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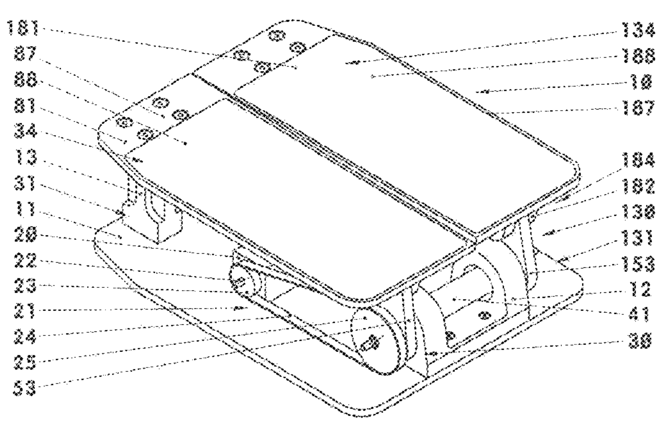
(57) ABSTRACT

In an apparatus for muscle stimulation with at least one motor and with two motor-operated drives, wherein each of these drives and a stepping plates are mounted in a frame and each of these drives is a revolving linkage square and the driven drive member is in each case a crank mounted in the frame, a crank and a stepping plate are in each case connected in an articulated manner by means of a coupling member providing for an apparatus for muscle stimulation with stepping plates that can be operated both with low and also with high stroke frequencies.

6 Claims, 6 Drawing Sheets



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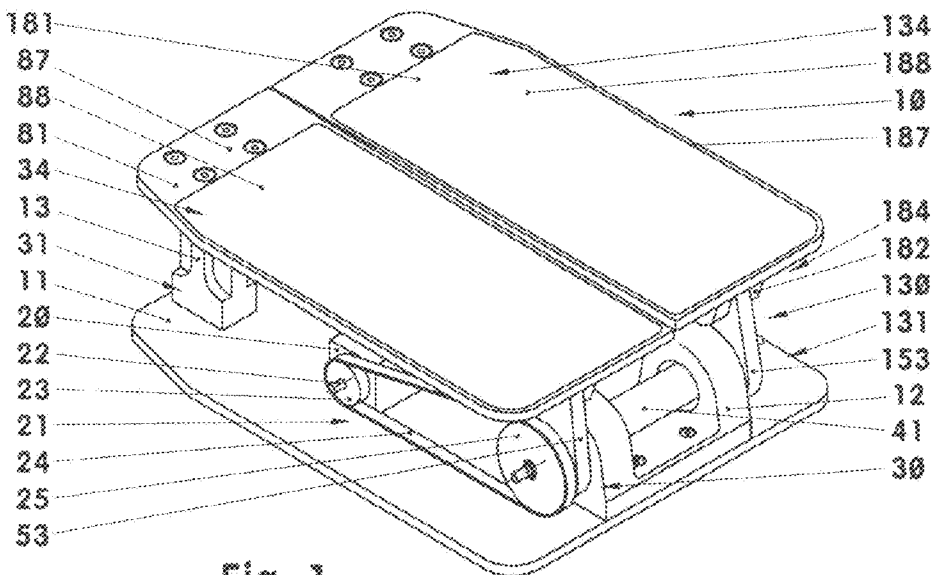


Fig. 1

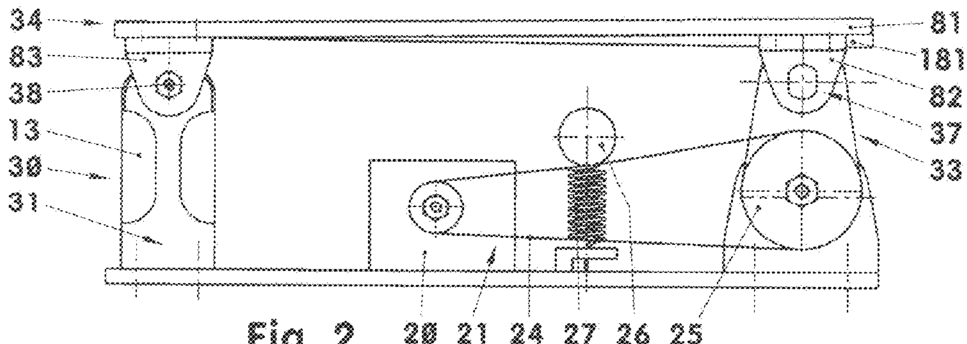


Fig. 2

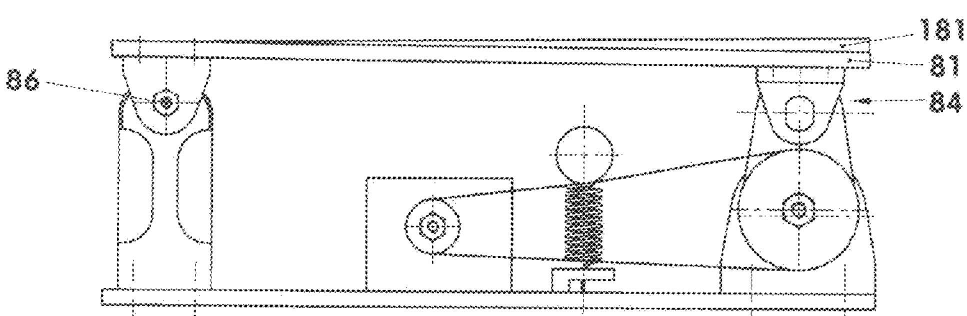
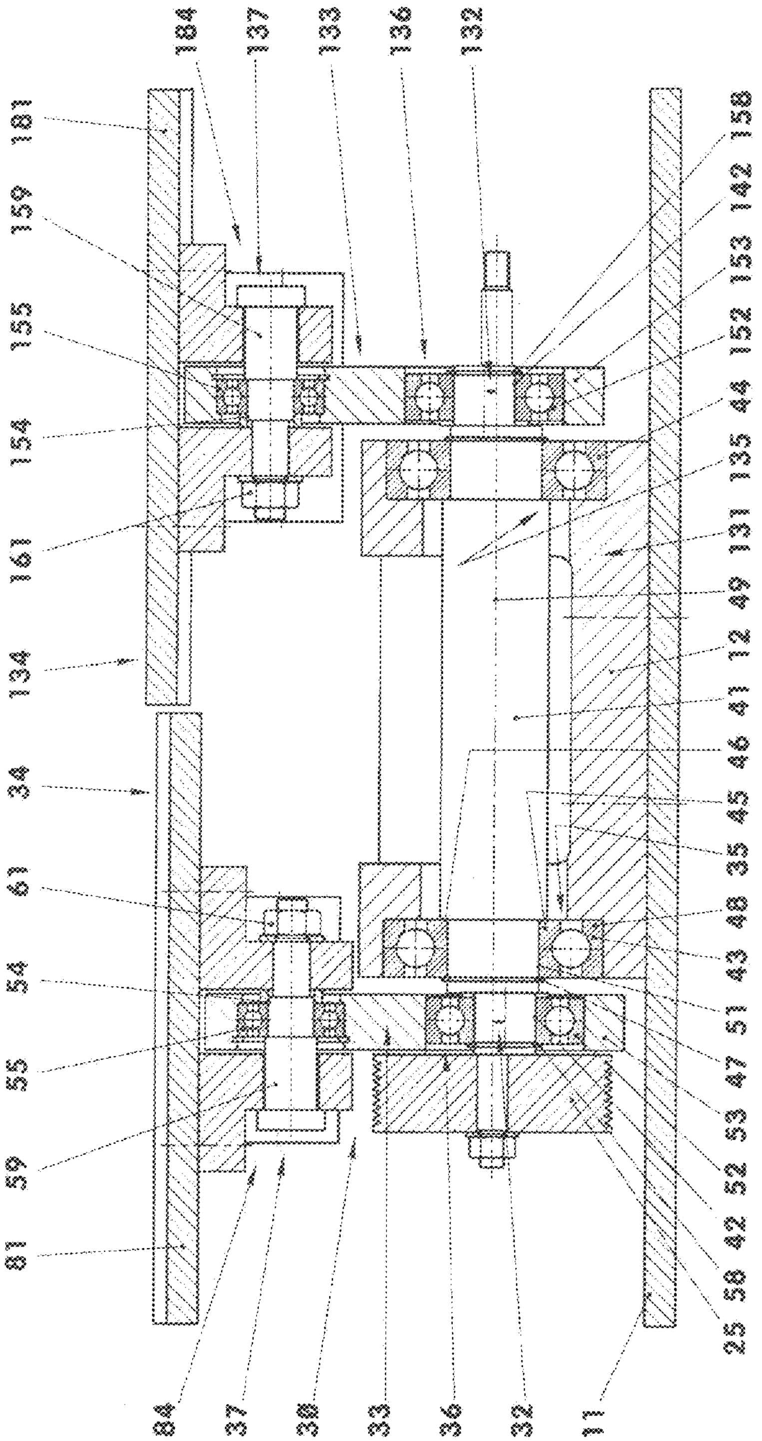


Fig. 3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44
135
131
49
12
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36
32
11

Fig. 4

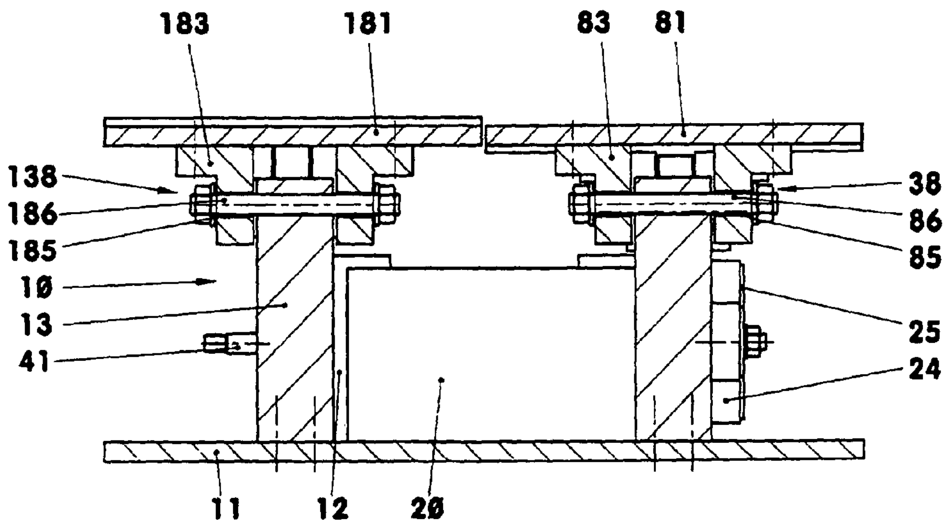

Fig. 5

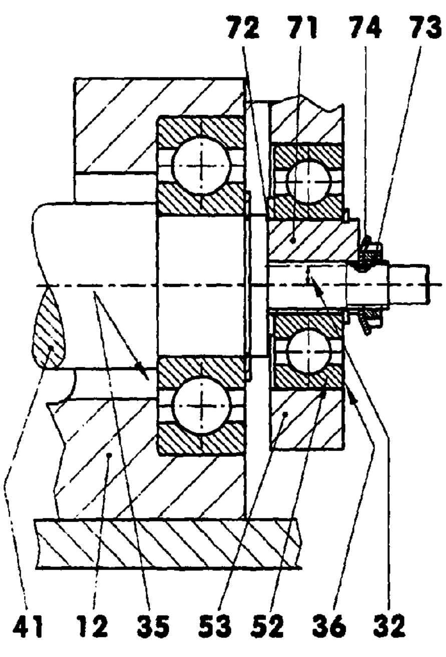

Fig. 6

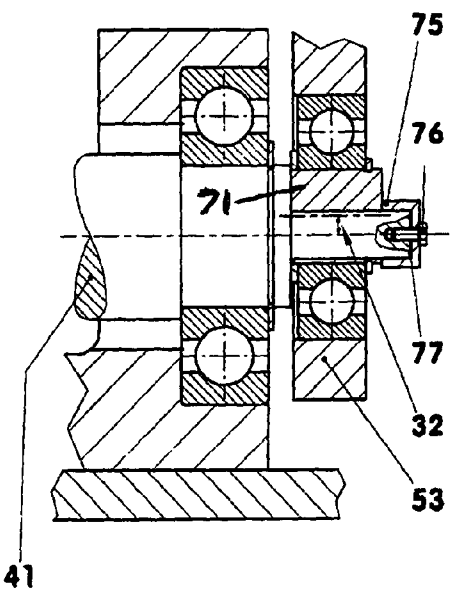

Fig. 7

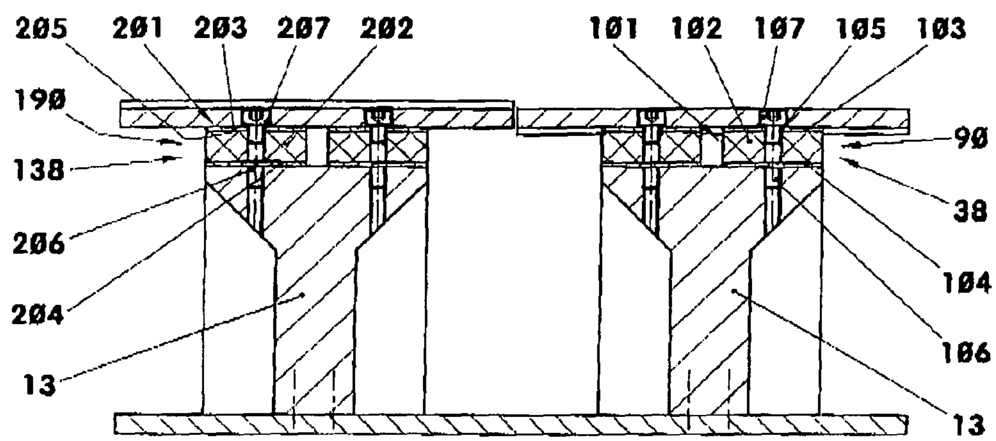
205
201
203
207
202
101
102
107
105
103
190
90
138
38
206
104
204
106
13
13

Fig. 8

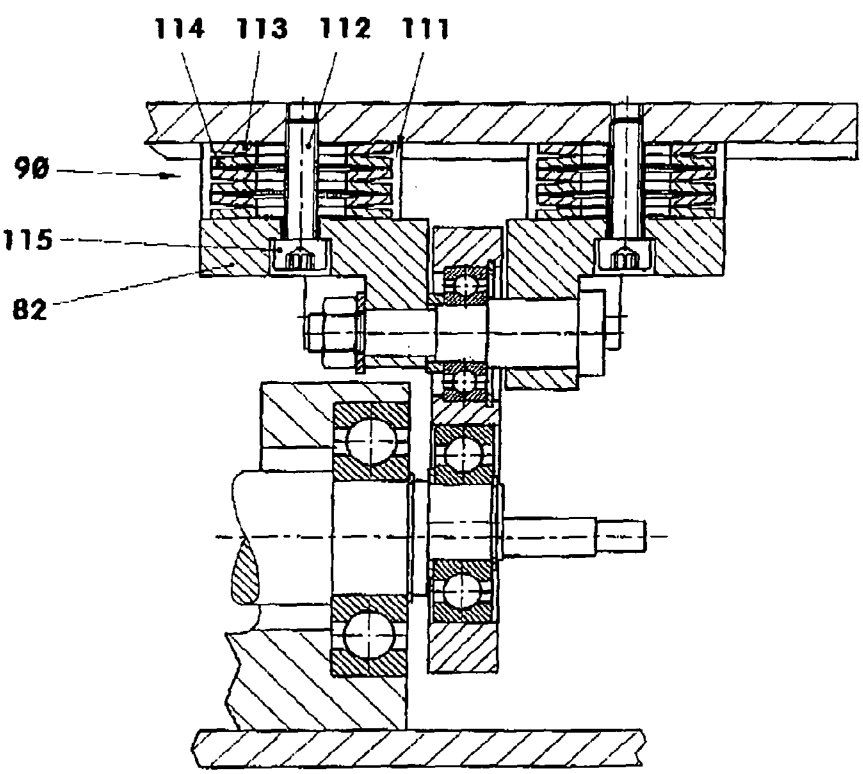
114
113
112
111
90
115
82

Fig. 9

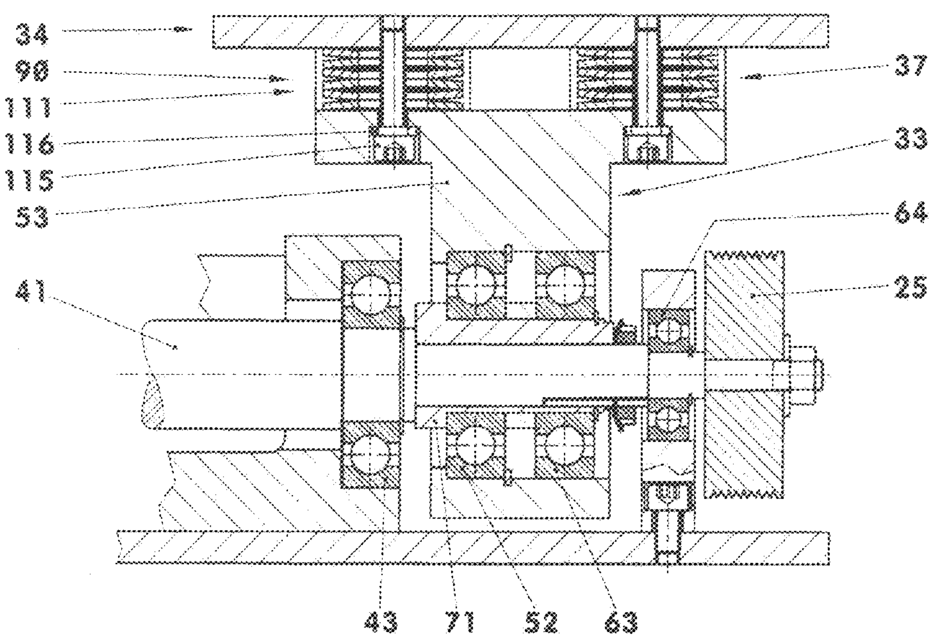

Fig. 10

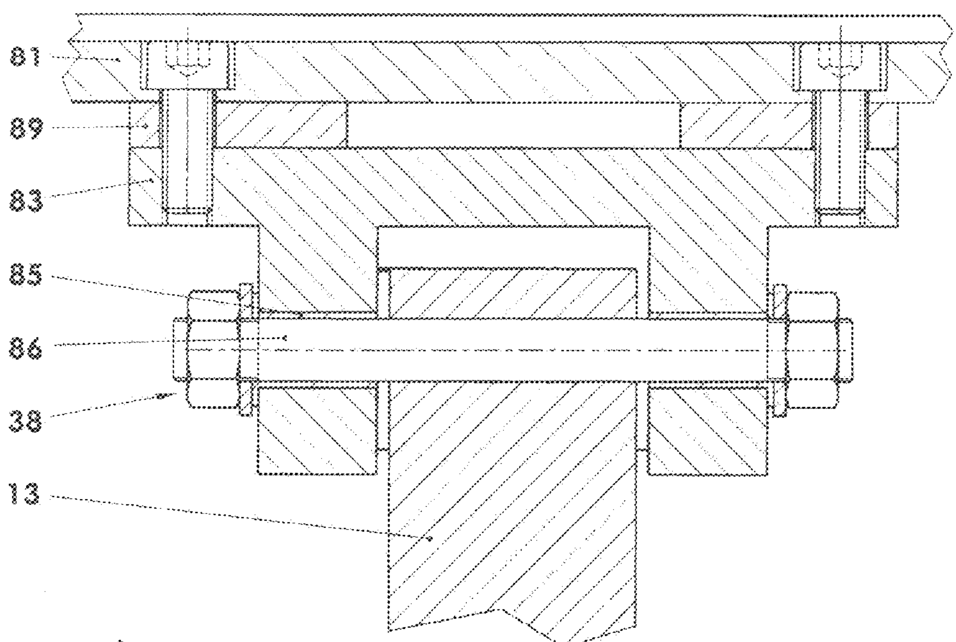

Fig. 13

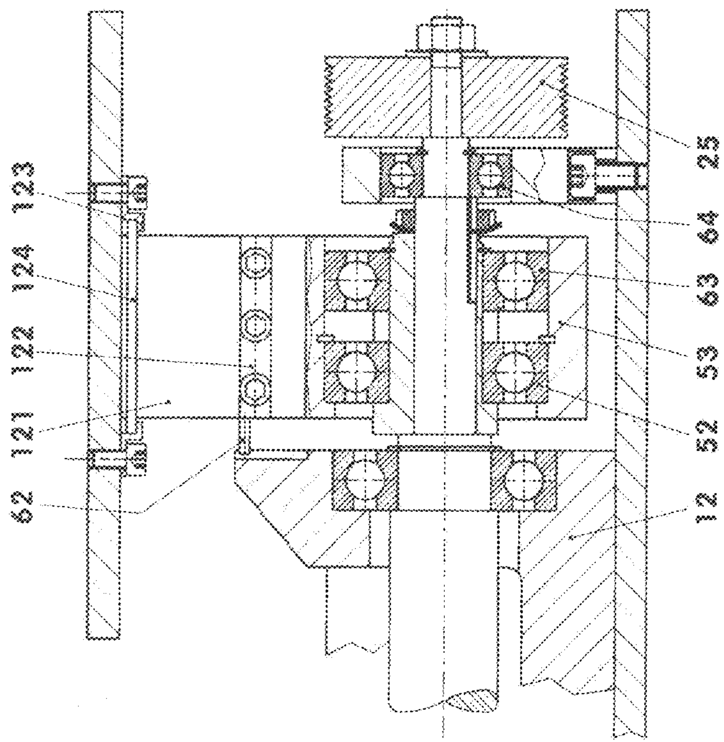
123
124
122
121
62
25
64
63
53
52
12

Fig. 12

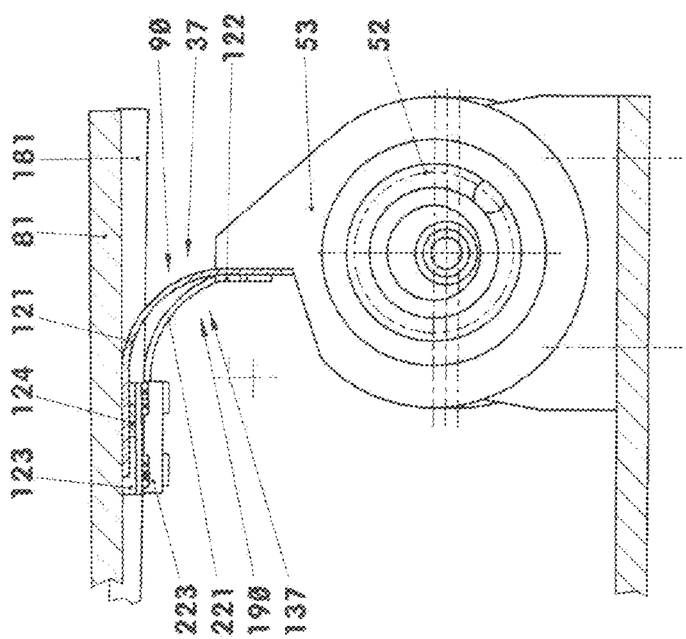
181
81
121
124
123
90
37
122
53
52
223
221
190
137

Fig. 11

APPARATUS FOR MUSCLE STIMULATION

This is a continuation-in-part application of pending international patent application PCT/DE2011/000310 filed Mar. 23, 2011 and claiming the priority of German patent application 10 2910 012 676.4 filed Mar. 21, 2010.

BACKGROUND OF THE INVENTION

The invention relates to an apparatus for muscle stimulation including a motor with two motor-operated drives wherein each of these drives comprises a frame and a stepping plate supported in the frame.

U.S. Pat. No. 3,540,436 A1 discloses such an apparatus. The individual drive is a three-member cam drive with a fully wrap-around cam surface. The manufacture of such a cam however requires special machinery and therefore is expensive to manufacture. In order to prevent a lift-off of the stepping plate, the stepping plate is pulled by a tension spring onto the rotating cam disc. Still, a high lift frequency may lead to lift-off of the stepping plate resulting in chatter noises.

It is therefore the object of the present invention to provide an apparatus for muscle stimulation, which can be operated at low as well as high frequencies.

SUMMARY OF THE INVENTION

This object is achieved with an apparatus having motor operated drives, wherein each drive comprises a quadrilateral linkage with a driven drive member being a crank supported in the frame. Furthermore, in each case, one crank and a stepping plate are pivotally interconnected by a coupling member.

The invention will become more readily apparent from the following description with reference to the schematic drawings:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows an apparatus for muscle stimulation;

FIG. **2** is a side view of the apparatus;

FIG. **3** is a side view after rotation of the crank by half a revolution;

FIG. **4** is a cross-sectional view of the drive;

FIG. **5** is a cross-sectional view of the stepping plate support in the frame;

FIG. **6** shows an adjustable eccentric;

FIG. **7** shows an eccentric with front cover;

FIG. **8** shows the support for the stepping plate by an elastomer body;

FIG. **9** shows the support for the stepping plate by plate springs;

FIG. **10** shows the stepping plate support without non-friction or friction bearings;

FIG. **11** shows the support of the stepping plate by leaf springs;

FIG. **12** is a partially sectional view of FIG. **11**; and

FIG. **13** shows a support including sensors.

DESCRIPTION OF A PARTICULAR EMBODIMENT

FIG. **1** shows a perspective view of an apparatus **10** for muscle stimulation. The apparatus **10** comprises a bottom plate **11** on which a motor **20** is disposed and two stepping plates **81**, **181** which are each driven by the motor **20** and a drive **30**, **130**. The operating elements of the apparatus **10** and the enclosure are not shown.

The motor **20** which is for example screwed to the bottom plate **11** is in the shown embodiment a frequency-controlled three-phase motor. By varying the control frequency of the magnetic field of the motor **20**, the speed of the motor **20** can be increased or decreased synchronously with the frequency. The apparatus **10** may also have two motors **20**. Then each of the two motors **20** drives one stepping plate **81**, **181** by way of a drive **30**, **130**. The two servomotors **20** may be synchronized with each other.

The individual motor may be a gear drive motor which drives for example directly an integral step-down gearing. The output speed of the gear drive motor, is then for example smaller than the described synchronous motor speed. The step-down gearing is a gear drive with parallel, cross-over or intersecting axes.

Also, the use of one or two DC motors with adjustable speed is possible.

In the arrangement as shown in FIG. **1**, the motor **20** is connected to the drives **30**, **130** by a pull member drive **21**. The pull member drive **21** is in the exemplary embodiment a belt drive, which comprises a belt pulley **23** disposed on the motor shaft **22**, a belt **24** and a belt pulley **25** disposed on the input shaft **41** of coupling drive **30**, **130**. The belt drive **21** may include a V-belt or a flat belt etc. The pull member drive **21** may also be a chain drive.

In the exemplary embodiment, the two belt pulleys **23**, **25** are V-belt rib pulleys **23**, **25**, wherein the driven pulley **25** has for example 2.2 times the diameter of the drive pulley **23** of the motor. The ribbed V-belt **24** may for example have a steel inlay.

For adjusting the belt tension, the motor **20** may be movable for example in the longitudinal direction of the apparatus **10**. The pull means **24** may also be tensioned by means of a self-tensioning arrangement, see FIGS. **2** and **3**. It comprises for example a tensioning roller **26** and a spring **27**.

In FIGS. **2** and **3**, the apparatus **10** is shown in each case in a side view, however with different drive positions. In FIG. **2**, the front stepping plate **81** facing the viewer is shown in its upper end position whereas the rear stepping plate **181** is shown in its lower end position. In FIG. **3**, the drive **30**, **130** is advanced to such an extent that the front stepping plate **81** is in its lower end position whereas the rear stepping plate **181** is in its upper end position.

The individual drive **30**, **130**—see FIGS. **1-5**, is a revolvable quadrilateral linkage square with a frame **31**, **131**, a crank **32**, **132**, a connecting member **33**, **133** and a further drive element formed by the stepping plate **81**, **181** and its support flanges **82**, **83**, **182**, **183**. The individual frame **31**, **131** is formed in the exemplary embodiment by the bottom plate **11**, a front bearing support **12** and a rear bearing support **13**. The support flanges **82**, **83**, **182**, **183** and the bearing supports **12**, **13** may comprise several parts. In the frame **31**, **131**, the crank **32**, **132**, on one hand, the crank **32**, **132** is rotatably supported in the crank joint **35**, **135** and, on the other hand, the stepping plate element **81**, **181** is rotatably supported in the frame joint **38**, **138**. In accordance with FIGS. **1-5**, the pivot axis and the axes of rotation of all of the joints **35-38**; **135-138** extend normal to a vertical longitudinal center plane of the apparatus **10**.

The crank **32**, **132** is formed by the drive shaft **41** with an eccentrically arranged bearing mount **42**, **142**. The input drive shaft **41** which, in accordance with the sectional representation of FIG. **4**, interconnects the two drives **30**, **130** carries at one end thereof the belt pulley **25**. It is rotatably supported in the front bearing support **12** for example by means of two grooved ball bearing **43**, **44**. The inner rings **45** of the bearings **43**, **44** abut a shaft shoulder **45** and are axially fixed on the shaft **41** by means of a locking ring **47**. In the exemplary embodiment the outer rings **48** abut the bearing support **12**.

The eccentrically arranged bearing mounts **42**, **142** are disposed in the exemplary embodiment outside the bearings **43**, **44**. They may for example be displaced relative to each other in a direction normal to the virtual center line **49** at the drive shaft **41**. In the exemplary embodiment, the extremities of the two eccentrically arranged bearing mounts **42**, **142** with respect to a rotational phase angle of the drive shaft **41** are displaced by 180°. The length of the **32**, **132** is the distance between the centerline **49** of the drive shaft **41** and the centerline of the eccentrically arranged bearing mount **42**, **142** of the respective coupling drive **30**, **130**. In the exemplary embodiment shown in FIGS. **1-5**, the sum of the diameter of an eccentrically arranged bearing mount **42**, **142** and twice the eccentricity is smaller than the diameter of the bearing support **51** of the input drive shaft (**41**).

The eccentrically arranged bearing mounts **42**, **142** support in the representation of FIG. **4** each a non-friction bearing **52**, **152**, which again carries each a support plate **53**, **153**. The support plate **53**, **153** forms the connecting member **33**, **133**, which is supported rotatably on the crank **32**, **132** by means of the connecting joint **36**, **136**. A second support mount **54**, **154** of the support plate **53**, **153** supports, by means of another non-friction bearing **55**, a pivot bolt **59**, **159** of the front stepping plate support structure **84**, **184**. The distance between the pivot axes of the bearings **52**, **55**, **152**, **155**, which extend parallel to each other is the length of the connecting member **33**, **133**. The non-friction bearings **43**, **44**, **52**, **55**, **152**, **155** are in the exemplary embodiment grooved ball bearings which are sealed at both sides. But roller bearings, inclined ball bearings, needle bearings etc., may also be used.

Each stepping plate **81**, **181** is supported on one hand via the connecting member **33**, **133** by means of a front stepping plate joint **37**, **137** an on the frame **31**, **131** by means of a frame pivot joint **38**, **138**. The frame support joints **38**, **138** comprise each a pivot bolt **86**, **186** supported in the rear by the rear bearing support (**13**), for example multipart support flange **83**, **183** by means of friction bearing sleeves **85**, **185** which consist of POM.

The two stepping plates **81**, **181** are arranged axially symmetrically with respect to a vertical longitudinal center plate of the apparatus **10**. For example, the constant distance of the two stepping plates **81**, **181** from each other is less than 2 millimeters. The individual stepping plate **81**, **181** is an at least approximately rectangular plate which consists for example of an aluminum alloy. In the exemplary embodiment, its length is 490 mm, its width is 200 mm and its thickness is 10 mm. Its top side **87**, **187** has a recessed surface area onto which a slip-resistant rubber mat **88**, **188** is cemented. At the top side **87**, **187** of the stepping plates **81**, **181** in each case one or several rope ears or hooks may be arranged into which a grommet of a rope provided with a handle may be hooked.

During assembly, for example, first the bearing supports **12**, **13** and the motor **20** are mounted onto the bottom plate **11**. The drive shaft **41** is then placed into the front bearing support **12** and a grooved ball bearing **43**, **44** is slipped onto the bearing supports **51** from the two shaft ends and in each case secured by means of a locking ring **47**. After the mounting of the support plates **53**, **153**, the grooved ball bearings **52**, **152** are slipped onto the eccentrically arranged bearing mounts **42**, **142** and secured for example by means of locking rings **58**, **158**. After sliding in the bearings **55**, **155**, the stepping plates **81**, **181** are put in place. In each case, a flange bolt **59**, **159** is inserted and secured for example by a hexagonal unit **61**, **161**. In the frame **31**, **131**, the individual stepping plate **81**, **181** is secured by means of the bolt **86**, **186**.

After installation and securing of the belt pulleys **23**, **25** and the belt **24**, the belt **24** is tensioned for example by a displacement of the motor **20**.

During operation of the apparatus **10**, the user stands with each foot on one of the stepping plates **81**, **181**. The motor **20** drives by means of the pull member drive **21** the two coupling drives **30**, **130**. In this way, with each rotation of the input drive shaft **41**, each crank is turned by one turn. The two connecting members **33**, **133** are positively actuated by the cranks **32**, **132** so that the stepping plate joints **37**, **137** are moved up and down from, for example, a neutral start out position. During one rotation of a crank, the respective support plate joint **37**, **137** reaches a maximum and a minimum. The overall stroke of the stepping plate joint **37**, **137** is for example 7 millimeter. The stroke frequency of the stepping plate **81**, **181** is between 3 Hz and 30 Hz.

During the oscillating stroke movement each of the two stepping plates pivots about the frame pivot joint **38**, **138**. The pivot angle out of the neutral position is for example +/− one angular degree.

The stroke frequency of the stepping plates **81**, **181** changes proportionally with the drive speed of the motor **20**. In this way, the stimulation of the muscles of the user is influenced.

FIG. **13** shows a stepping plate **81** with a support flange **83** wherein a pressure sensor **89** is arranged between the two components **81**, **83**. If for example at high frequency, the foot of the user is partially lifted off the stepping plate **81**, the load on the stepping plate is reduced and is suddenly reapplied when the foot load is reinstated. The electrical output signal of the sensor, which for example is in the form of a pressure sensor cell or an expansion measurement strip, is changed. This signal change causes the control arrangement of the motor **20** for example to reduce the motor speed. Only when the feet of the user are again fully disposed on the stepping plates the original signal level of the sensor **89** which reacts to deformations is again re-established.

Such sensors **89** may be arranged in, or on, the frame-side stepping plate support joint **38** as well as at the coupling-side stepping plate support joint **37**. The summing signal of the two sensors **89** then is to a large extent independent of the position of the user on the stepping plate **81**, **181**.

For the evaluation, a control signal depending on the mass or, respectively, the mass moment of inertia of the user may be determined but only after an initial operation of for example 10 seconds.

FIG. **6** shows a partial sectional view of an apparatus **10** in the area of a drive shaft **41** which comprises coaxial cylindrical sections. On the drive shaft **41**, eccentric ring **71** is disposed, which carries the stepping plate bearing **52** and which abuts a shaft shoulder **72** and is secured by means of a shaft nut **73** and a locking plate **74**. The eccentric ring **71** may be provided at the nut- and/or shoulder side with a planar teeth structure which is engaged by a counter-tooth structure provided on the shaft shoulder **72** or a locking ring **74** of the shaft unit **73**. The eccentric ring **71** may be positioned on the drive shaft **41** for example by means of a fitting spring. The eccentric ring **71** may be exchangeable for example by another eccentric ring with different eccentricity.

In order to adjust the eccentricity and consequently the length of the crank **32**, the shaft unit **23** is loosened. The eccentric ring **71** can then be steplessly rotated for example on the basis of a scale. When the new crank length is adjusted, the crank unit **73** is again tightened. With a form-locking structure disposed for example between the eccentric ring **71** and the shaft should **72**, a step-wise adjustment of the crank length is possible. With an adjustability of the eccentricity of the connecting joint **36**, the stroke of the stepping plate **81** is adjustable. In the exemplary embodiment, a stroke adjustment of between two and seven millimeter is possible.

The two drives **30**, **130** may have different crank length. To this end, the eccentric rings **71** may be adjusted differently. As a result, the stroke travel of the two stepping plates **81**, **181** may be different.

The two drives **30**, **130** may also be so adjusted that the phase displacement of the two maxima and/or minima differs from 180 degrees. To this end, the two stepping plates **81**, **181** are so adjusted that the maximum of the one stepping plate does not coincide, time wise, with the minimum of the other stepping plate **81**, **181**. In this case, the drive shaft **41** may be provided with an eccentric weight for mass compensation.

FIG. **7** shows a drive shaft **41** with an eccentric ring **71** which is fixed by means of a front cup **75**. The front cup **75** is mounted cup **75** is mounted to the front end **77** of the drive shaft **41** for example by means of a screw **76**. A connection by means of two screws, a form-locking element, for example a locking pin and a screw **76** etc. . . . is also possible. Also, in this case a scale may be provided on the front cup **75** on the basis of which the eccentric ring **71** may be adjusted by means of counter marks.

The eccentric ring **71** may also be fixed by means of a rapid clamping arrangement. Herein the eccentric ring **71** may be operated from outside of the apparatus **10** by loosening or clamping of an operating handle. Also, the eccentric adjustment may be performed for example from the outside by means of a tool.

FIG. **8** shows the support of two stepping plates **81**, **181** by way of elastically deformable elements **90**, **190**. They are two composite bodies **101**, **201** formed each by an elastomer body **102**, **202** with metal plates **103**, **104**, **203**, **204** vulcanized onto the front sides thereof. The upper metal plate **103**, **203** has for example a threaded bore **105**, **205**. The lower metal plate **104**, **204** carries a threaded pin **106**, **206** which projects from the elastomer body **106**, **206** and which is threaded into the respective bearing support **13**. Into the threaded bore **105**, **205** in each case a mounting screw **107**, **207** for mounting the stepping plate **81**, **181** is threaded. The elastomer body **102**, **202** has for example a hardness of between 40 and 60 shore. The composite body **101**, **201** prevents in this way abrupt strike exposures of the user which could occur at reversal points of the stepping plate movements.

During operation of the apparatus **10** with such a frame- and/or coupling-side stepping plate support arrangement **37**, the elastomer body **102**, **202** also permits an inclined position of the two metal plates **103**, **104**, **203**, **204** relative to each other up to an angle of, for example, three degrees. The composite body **101**, **201** could therefore replace the friction or non-friction bearing support of the stepping plates **81**, **181** as shown in FIG. **5**. But it may also be provided in addition to the bearings.

FIG. **9** shows a double-sided stepping plate support arrangement **37** which comprises as elastically deformable elements **90**, **190** two plate spring packets **111**. Here, for example, in each case, a screw **112** is threaded from the bottom through the support flange **82** and the plate spring packet **111** into the stepping plate **81**. The pretension of the plate spring packet **111** is adjustable by means of the screws **112**. In this way, the stepping plate support **37** can be adjusted to be harder or softer.

As shown in FIG. **9**, in each case one plate spring **113** of a plate spring packet **111** is oriented upwardly whereas the adjacent plate spring **114** is oriented downwardly. But it is also possible to combine and orient two adjacent plate springs **113** upwardly and the next two adjacent ones **114** downwardly.

In the arrangement of FIG. **9**, the coupling-side stepping plate joint or support **37** may be provided, instead of by a non-friction bearing **55**, by a leaf spring. The leaf spring is then attached to the support plate **53** and the support flange **82**. The bending line then extends for example parallel to the bottom plate **11**.

The screw head **115** may for example be disposed on an arched washer **116** provided with an elongated opening, see FIG. **10**. The washer may have a surface with a small friction coefficient. In the embodiment of the stepping plate support **37**, **38** without friction and/or antifriction bearing the described support structure may also take on the joint function.

Also, the use of a composite body with an elastomer body and front metal plates with a throughbore instead of the plate spring packets **111** is possible.

FIGS. **11** and **12** show an apparatus **10** whose coupling-side stepping plate joints **37** comprise leaf springs **121**. In FIG. **11**, the belt pulley **25** and the support bearing **64** are removed. FIG. **12** shows a partial sectional view of FIG. **1** in the area of the support plate **53**. The individual elastically deformable element **90**, **190**, that is, the individual bent leaf spring **121**, **221**, is mounted to the support plate **53** so as to extend for example at least approximately vertically. In addition, it is locked by means of a locking sheet **122**. In the exemplary embodiment, the support plate **53** is vertically guided by means of a guide bolt **62** in the front support **12**.

At the stepping plate side, the leaf springs **121**, **221** are supported at the bottom side of the stepping plates **81**, **181**, for example, in each case in two guide tracks **123**, **223**. An adjustment sheet **124** which is adjustable in the longitudinal direction of the stepping plate **81**, **181** is pressed onto the leaf spring **121** by means of the guide elements **123** so that the leaf spring position relative to the stepping plate **81**, **181** is maintained. By an axial adjustment of the adjustment sheet **124**, the spring length of the leaf spring and as a result the spring stiffness can be adjusted. The shorter the spring length, the higher is the stiffness of the support.

Also a multi-layer leaf spring pack may be used. In order to increase the stiffness of the support, two or several leaf springs **121** may also be arranged in parallel relationship.

Such a coupling-side stepping plate arrangement **37** may be combined for example with a frame-side stepping plate support **38** including a composite body **101**.

FIG. **12** discloses three identical non-friction bearings **43**, **53**, **63** for supporting a stepping plate **81**, **181**. The support bearing **64** in the form of a loose bearing has in the exemplary embodiment has with regard to these bearings a smaller inner and outer diameter. However, it also possible to use identical bearing elements for all non-friction bearing locations.

Also, in such an apparatus **10**, the crank length and/or the phase angle difference may be adjustable.

The pull member drive **21** may be arranged between the two drives **30**, **130**. It is also possible to provide a pull member drive **21** for each drive **30**, **130**. It is also possible not to use any pull member drive **21** for the apparatus **10**.

Also combinations of the various exemplary embodiments are possible.

Listing of Reference Numerals	
10	Apparatus for muscle stimulation
11	Bottom plate
12	Bearing support
13	Bearing support, front
20	Motor
21	Pull member drive, belt drive
22	Motor shaft
23	Belt pulley, input side; gear disc pulley
24	Pull means, belt, gear belt
25	Belt pulley, output side, gear disc pulley
26	Tensioning roller
27	Spring
30	Drive, coupling drive
31	Frame
32	Crank
33	Connector, connecting member
35	Crank joint, rotational support
36	Connecting joint, rotational support
37	Stepping plate joint, front stepping plate joint, pivot bearing, coupling-side stepping plate support
38	Frame joint, pivot joint
41	Drive shaft
42	Bearing mount, eccentrically arranged
43	Non-friction bearing, grooved ball bearing
44	Non-friction bearing, grooved ball bearing
45	Inner ring
46	Shaft shoulder
47	Locking ring
48	Outer ring
49	Centerline of (41)
51	Bearing support of (41)
52	Non-friction bearing, grooved ball bearing
53	Support plate
54	Support seat
55	Antifriction bearing, grooved ball bearing
58	Locking ring
59	Flange bolt
61	Hexagonal nut
62	Guide bolt
63	Non-friction bearing
64	Support bearing
71	Eccentric ring
72	Shaft shoulder
73	Shaft nut
74	Locking plate, locking ring
75	Front cup
76	Screw
77	Front end of shaft 41
81	Stepping plate, drive element
82	Support flange, front
83	Support flange, rear
84	Stepping plate support, front
85	Friction bearing sleeve
86	Pivot bolt
87	Top side
88	Rubber mat
89	Pressure sensitive sensor
90	Elastically deformable element
101	Composite body
102	Elastomer body
103	Metal plate
104	Metal plate
105	Threaded bore
106	Threaded pin
107	Mounting screw
111	Plate spring packet
112	Screw
113	Plate spring
114	Plate spring
115	Screw head
116	Washer
121	Leaf springs
122	Retaining sheet
123	Guide track
124	Adjustment sheet
130	Drive
131	Frame
132	Crank
133	Connector, connecting member

-continued

Listing of Reference Numerals	
135	Crank joint
136	Coupling joint
137	Stepping plate joint
138	Frame joint
142	Bearing mount, eccentrically arranged
152	Non-friction bearing. Grooved ball bearing
153	Support plate
154	Support mount
155	Anti-friction bearing, grooved ball bearing
158	Locking ring
159	Flange bolt
161	Hexagonal nut
181	Stepping plate
182	Support flange, front
183	Support flange, rear
184	Stepping plate support structure, front
185	Slide sleeve
186	Pivot bolt
187	Top side
188	Rubber mat
190	Elastically deformable element
201	Composite body
202	Elastomer body
203	Metal plate
204	Metal plate
205	Threaded bore
206	Threaded pin
207	Attachment screw
221	Leaf spring
223	Guide track

What is claimed is:

1. An apparatus (**10**) for muscle stimulation including at least one motor (**20**) with two motor-operated drives (**30**, **130**) interconnected by a drive shaft (**41**) each of the motor-operated drives (**30**, **130**) comprising a frame structure (**31**, **131**) and two separate stepping plate elements (**81**, **181**) supported in the frame structure (**31**, **131**) by pivot bearing structures (**38**, **138**) arranged at one end of the stepping plate elements (**81**, **181**) and by elastically deformable elements (**90**, **190**) supporting the stepping plate elements at their ends opposite the pivot bearing structures (**38**, **138**) on support flanges (**82**, **182**),

each of the motor-operated drives (**30**, **130**) forming a quadrilateral linkage with a rotatable link formed by en eccentric ring (**71**) defining a crank (**32**, **132**) of the drive shaft (**41**) supported on the frame structure (**31**, **131**) in each of the motor-operated drives (**30**, **130**),

one of the cranks (**32**, **132**) being connected pivotally to an end of one of the stepping plate elements (**81**, **181**) opposite the respective pivot bearing structure (**38**, **138**) and the other crank (**132**, **32**) being pivotally joined to the other stepping plate element (**81**, **181**) at the other end of the respective pivot bearing structure by coupling members (**33**, **133**) and the stepping plate elements (**81**, **181**) further being spaced from each other by a spacing of less than 2 mm.

2. The apparatus (**10**) according to claim **1**, wherein the length of each crank (**32**, **132**) is adjustable.

3. The apparatus (**10**) according to claim **1**, wherein the phase angle position of the two cranks relative to each other is adjustable.

4. The apparatus (**10**) according to claim **1**, wherein the speed of each of the two motor operated drives (**30**, **130**) is adjustable.

5. The apparatus (**10**) according to claim **1**, wherein the stiffness of the elastically deformable element (**90**,**190**) is adjustable.

6. The apparatus (**10**) according to claim **1**, wherein at least one pivot joint (**37**, **38**, **137**, **138**) of stepping plate elements (**81**, **181**) includes a sensor reacting to deformations.

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